

WHAT IS CLAIMED IS

1. A plasma processing apparatus for plasma-processing a surface of a substrate having an insulating layer on a front surface that is accommodated in a processing room, comprising:

an electrode that is a conductor and has a top surface that is greater in external size than the substrate;

cooling means for cooling the electrode;

a DC power section for applying a DC voltage to the electrode to cause the top surface of the electrode to hold the substrate by electrostatic absorption;

pressure lowering means for lowering pressure inside the processing room;

a plasma generation gas supply section for supplying a plasma generation gas to the processing room; and

a radio-frequency power section for generating plasma in the processing room by applying a radio-frequency voltage to the electrode,

wherein the top surface of the electrode has a top surface central area that is inside a boundary line that is distant inward by a prescribed length from an outer periphery of the substrate and in which the conductor is exposed, and a ring-shaped top surface peripheral area that surrounds the top surface central area and in which the conductor is covered with an insulating coating.

2. The plasma processing apparatus according to claim 1, wherein an outer peripheral portion of the insulating layer of the substrate being held by the top surface of the electrode is in contact with the insulating coating in an area
5 between the outer periphery and the boundary line.

3. The plasma processing apparatus according to claim 1, comprising an insulating portion that covers an outer peripheral portion of the insulating coating in ring form.
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4. The plasma processing apparatus according to claim 1, wherein the insulating coating extends to cover part of a side surface of the electrode.

15 5. The plasma processing apparatus according to claim 1, wherein the insulating coating is made of alumina.

6. A plasma processing method in which an electrode that is a conductor and has a top surface that is greater in
20 external size than a substrate to be plasma-processed that has an insulating layer on a front surface thereof is provided in a processing room, the top surface of the electrode has a top surface central area that is inside a boundary line that is distant inward by a prescribed length from an outer periphery of the
25 substrate and in which the conductor is exposed and a ring-shaped top surface peripheral area that surrounds the top surface

central area and in which the conductor is covered with an insulating coating, and plasma processing is performed in a state that the substrate is held by the top surface of the electrode by electrostatic absorption and the electrode is being cooled,
5 characterized in:

that the substrate is mounted on the top surface of the electrode in such a manner that a central portion and a peripheral portion of the insulating layer of the substrate are in contact with the top surface central area and the insulating coating
10 in the top surface peripheral area, respectively;

that the substrate is electrostatically absorbed on the top surface central area by mainly utilizing the central portion of the insulating layer as a dielectric for electrostatic absorption; and

15 that the top surface central area of the electrode is insulated from plasma by bringing the outer peripheral portion of the insulating layer into close contact with the insulating coating.

20 7. The plasma processing method according to claim 6, wherein the substrate is a semiconductor substrate on the front surface of which logic circuits are formed, and that a back surface of the semiconductor substrate is etched by the plasma processing.

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8. The plasma processing method according to claim

7, wherein microcracks that have developed on the back surface of the semiconductor substrate in mechanical processing are etched away.